ENERGY

Supply and Requirements Forecast 1990 2010

Province of British Columbia
Ministry of Energy, Mines
and Petroleum Resources

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Efficient Energy
Cutting energy waste lowers consumer energy bills, benefits the environment, and makes British Columbia industry more competitive.

Clean Energy
Shifting to cleaner fuels and reducing the environmental impacts of energy supply and use will help improve the quality of our air, water, and other natural resources.

Secure Energy
Managing existing resources effectively, finding new sources of supply, increasing fuel choice for consumers, and maintaining the quality and quantity of energy supplies will ensure long-term energy security for the province.

Energy for the Economy
Developing energy resources across British Columbia will stimulate regional growth and bring economic benefits to the province as a whole.

Canadian Cataloguing in Publication Data

Main entry under title:
Energy supply and requirements forecast. –
1990/2010-

Biennial.
Continues: British Columbia energy supply and requirements forecast. ISSN 0832-820X.
ISSN 1183-3890 = Energy supply and requirements forecast

1. Energy consumption – British Columbia – Periodicals. 2. Energy consumption – British Columbia – Forecasting – Periodicals. 3. Power resources – British Columbia – Periodicals. I. British Columbia. Energy Resources Divison. Energy Management Branch.

TJ163.25C3E55 333.79'09711 C91-0992088-5

Energy Supply and Requirements Forecast

1990–2010

Ministry of Energy, Mines and Petroleum Resources
March 1991

91-04256/

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Executive Summary

OVERVIEW

- Between 1990 and 2010, British Columbia's end use energy requirements are forecast to grow at 1.4 percent per year on average, compared to 1.0 percent during the 1980s. End use requirements will increase from 1012 to 1337 petajoules (PJ), while primary requirements (which include fuels lost in conversion processes) will rise from 1064 to 1393 PJ.
- Natural gas and electricity will increase their market shares of total demand, at the expense of oil products and other fuels.
- Total energy use per dollar of output (GDP) fell by 15 percent from 1980 to 1990. This decline is expected to continue due to more energy-efficient vehicles and equipment, better building design, substitution towards more efficient fuels, and growth in less energy-intensive industry.
- British Columbia will become a net exporter of energy by the year 2010. Increased exports of electricity and natural gas will offset imports of crude and refined oil.

ELECTRICITY

- Provincial electricity requirements are projected to increase at an average 2.2 percent annually, compared to 3.1 percent over the 1980s.
- The main sources of demand growth are process changes in the pulp and paper industry and increased penetration of electrical equipment in the commercial sector and secondary manufacturing.
- Electricity prices will fall relative to other fuels during the forecast period.
- Privately-owned thermal generation will increase its share of electricity supply. New power resources, beyond those currently planned, will be needed in the post-2000 period.

NATURAL GAS

- Domestic natural gas consumption is expected to grow at 2.3 percent per year on average, compared to 3.0 percent over the past decade.
- Natural gas will remain the least expensive fuel in all markets, although its price will rise relative to electricity and oil prices.
- Demand growth is due primarily to the Vancouver Island natural gas pipeline and the capture of space heating loads in new construction.
- Given large reserves and increased exploration and development activity, gas supply will be more than sufficient to cover both domestic and export needs.

OIL/OTHER FUELS

- Provincial oil requirements are expected to grow at 0.5 percent per year from 1990 to 2010, compared to an average annual decline of 1.2 percent since 1980. Requirements for other fuels (forest wastes, coal and coke, etc.) will increase at an annual 0.6 percent, half their growth rate during the 1980s.
- Prices for oil products are forecast to remain low in the medium-term and then rise after the mid-1990s, although not as fast as natural gas prices. (The forecast for oil prices was made prior to recent events in the Middle East, which will affect price levels in the short-term.)
- All of the growth in oil demand comes from transportation, which accounts for 70 percent of total oil product requirements.
- As provincial reserves decline, the share of total oil supply made up by imports (mainly from Alberta) will rise from 80 to 94 percent by the year 2010.

SECTORAL REQUIREMENTS

- The fastest growing energy use sectors will be the commercial and residential sectors. The pulp and paper sector will outgrow most industrial sub-sectors while transportation energy requirements will exhibit the slowest rate of growth. Average annual rates of growth for sectoral energy requirements are:

Commercial	2.2%
Residential	1.8%
Industrial	1.3%
Transportation	1.1%

EFFICIENT/CLEAN ENERGY

- Energy efficiency and a clean environment are major goals for energy policy in the 1990s.
- Utility and government energy efficiency programs will result in lower electricity and natural gas demand.
- Clean energy initiatives in the province include the development of renewable energy, switching to cleaner fuels (e.g., natural gas), improvements in energy efficiency, and the promotion of alternative transportation fuels.

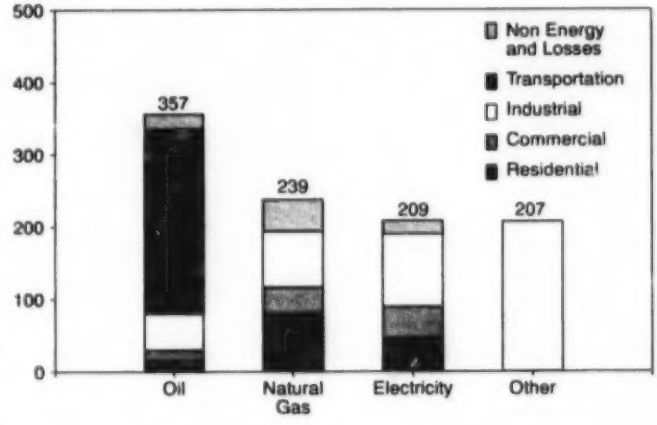
Overview

British Columbians produce and consume large amounts of energy. Our domestic reserves of hydroelectric power, natural gas, coal, and usable forest wastes are substantial. Provincial oil reserves, on the other hand, are small and declining.

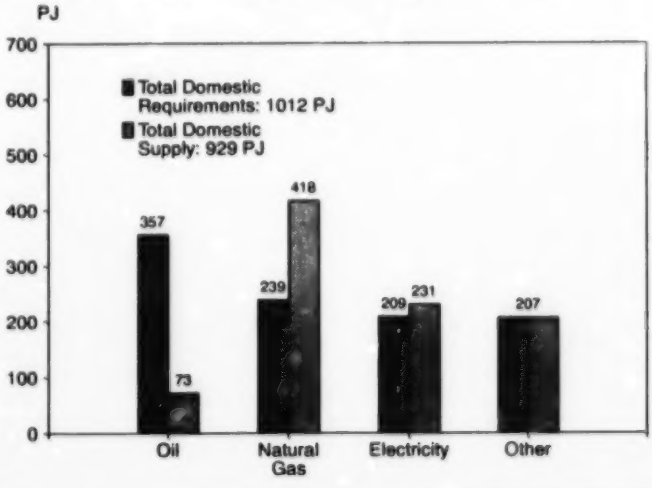
British Columbia is a net exporter of electricity and natural gas, and a net importer of crude oil and oil products. In 1990, on balance, the province was a net importer of total energy by 83 petajoules (PJ), or just over eight percent of total domestic requirements. By 2010 British Columbia will be a net exporter of energy. Increased exports of electricity and natural gas will offset imports of crude oil and oil products.

In addition, British Columbia produces about 750 PJ of coal, 99 percent of which is exported. If coal is included in the supply-requirements balance, then the province produces about 65 percent more energy than is needed for domestic use.

Energy Requirements by Fuel and by Sector (1990)



Energy Supply and Requirements by Fuel (1990)



Both the private and public sectors contribute to provincial energy supplies. Oil, natural gas, and industrial (primarily forest) wastes are produced by the private sector.

Seventy-eight percent of electricity is produced by B.C. Hydro, a Crown Corporation, with the remainder generated by private utilities and industry.

TOTAL ENERGY REQUIREMENTS

Between 1990 and 2010, total end use energy requirements are forecast to grow by 325 PJ, from 1012 to 1337 PJ. This represents an average annual growth rate of 1.4 percent, compared to 1.0 percent for the 1980–90 period.

Primary energy requirements are forecast to grow by 329 PJ, from 1064 in 1990 to 1393 PJ by 2010. These requirements differ from end use demand by the amount of energy lost in converting other fuels to electricity and crude oil to refined products.

Key assumptions underlying the forecast include:

- provincial population growth of 1.7 percent per year;
- real economic growth of 2.7 percent per year; and
- general inflation of 3.9 percent per year on average to the forecast horizon.

ENERGY REQUIREMENTS BY FUEL

British Columbia's energy requirements are met from refined petroleum products (RPPs), natural gas, electricity, and other fuels — primarily forest wastes and coal and coke. During the forecast period, the main movement in fuel market shares is a shift away from oil, and to a lesser extent other fuels, and into natural gas and electricity.

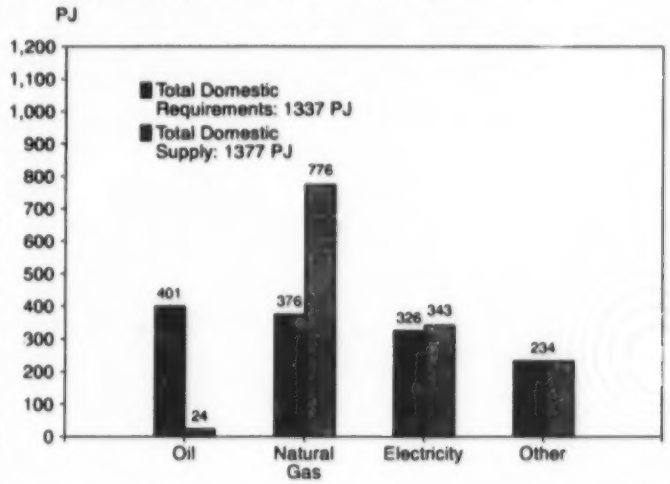
The decline in oil's market share continues an historical off-oil trend that saw RPP requirements fall by an average 1.2 percent per year between 1980 and 1990.

ENERGY REQUIREMENTS BY SECTOR

By consuming sector, industry and transportation account for the largest shares of total energy requirements. If non-energy uses of fuel (e.g., petrochemical feedstocks, which are classified under "other") are included, industry accounts for about half of total provincial requirements.

By individual fuel, transportation dominates the use of oil products, while industry accounts for virtually all of "other" fuels (forest wastes). The use of natural gas and electricity is more evenly distributed over the residential, commercial, and industrial sectors.

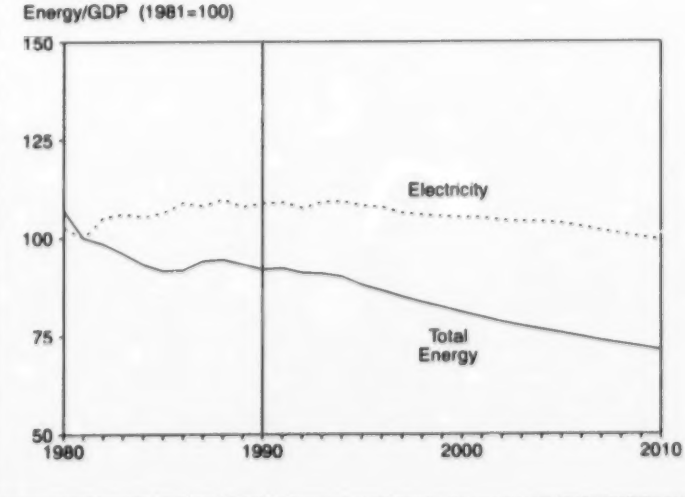
Energy Supply and Requirements by Fuel (2010)



ENERGY INTENSITY

British Columbia's energy use per dollar of output is among the highest of any industrialized region in the world. This is due, in large part, to the predominance of energy-intensive, resource-based industries such as pulp and paper, mining and smelting.

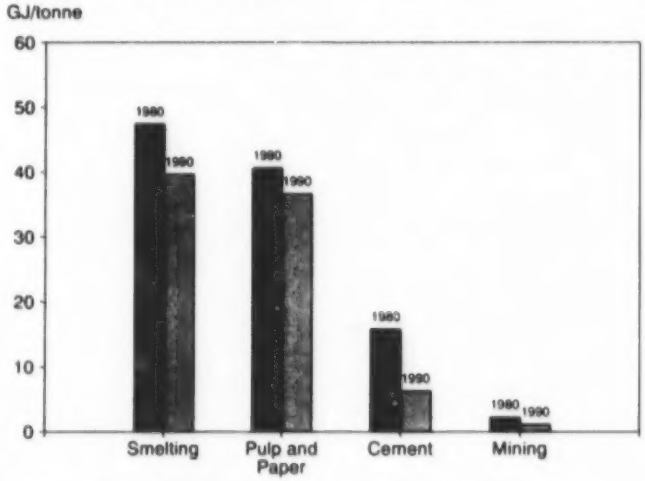
Energy Intensity



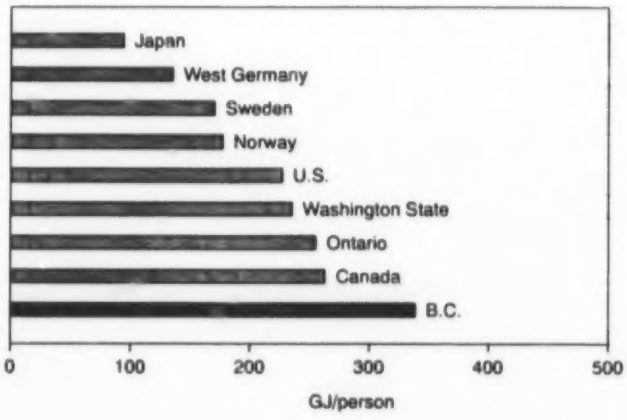
Trends in energy demand per dollar of Gross Domestic Product (GDP) are often used to indicate whether the efficiency of energy use has improved. Between 1980 and 1990, total provincial energy requirements per dollar of GDP fell by 15 percent. In the future, this trend is expected to continue.

Electricity intensity increased over the 1980–1990 period, reflecting the increased penetration of electrical appliances and equipment. Electricity use per dollar of GDP is forecast to level out, as the trend towards electrification is offset by greater efficiency improvements.

Energy Use per Unit of Physical Output



Energy Use per Capita



REPORT STRUCTURE

The remainder of this report provides some background on the forecast in terms of policy and economic considerations, energy requirements by fuel and by sector, and energy efficiency and environmental issues.

Details on both primary and secondary energy demand are shown at the back of the report, along with key assumptions of the forecast. More detailed information from the forecast can also be obtained from the Energy Management Branch.

Assumptions

A number of developments in government policy and economic conditions have implications for the forecast.

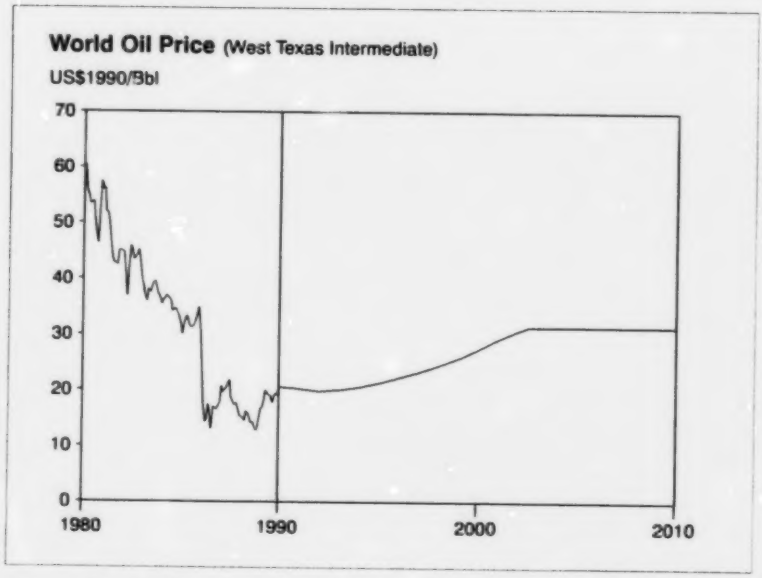
VANCOUVER ISLAND NATURAL GAS PIPELINE

Construction is underway on a pipeline to bring natural gas to Vancouver Island and mainland coastal areas. Gas is expected to be available in Squamish and the Sunshine Coast in mid-1991, and in Victoria by the fall of that year. Total domestic gas demand is expected to increase by 10 percent as a result of the pipeline. Approximately 19 PJ of oil products will be displaced.

WORLD OIL PRICES

The price of West Texas Intermediate is forecast to range, in real 1990 U.S. dollars, between $20 and $23 per barrel during the next five years, rising to $30 by the end of the decade.

Oil prices were extremely volatile in 1990, due to the Iraqi invasion of Kuwait. Crude oil prices will remain volatile in the short-term but in the long-term average levels will be determined by underlying market fundamentals.



ECONOMIC CONDITIONS

The underlying forecast of economic growth is based on the Ministry of Finance and Corporate Relations' British Columbia Long-Term Economic Forecast, 1990 to 2010 published in May 1990. Provincial real (inflation-adjusted) GDP is projected to grow at a rate of 3.0 percent in 1990, 1.5 percent in 1991, and at an average of 2.8 percent per year thereafter. An economic slowdown is assumed for 1991, due to the recent rise of the Canadian dollar and flat/declining export markets. The forecast does not incorporate a major economic recession at home or abroad.

The strong U.S. and world economies assumed throughout the forecast have significant positive impacts on British Columbia's export oriented economy. Forestry and mining as well as related manufacturing will continue to contribute a major portion of the province's economic output.

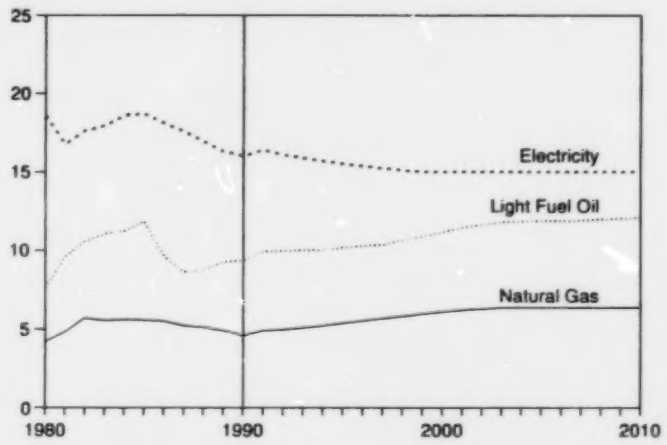
The population forecast reflects the resurgence in inter-provincial migration that has occurred in recent years and which persists throughout the forecast. British Columbia's relatively strong economy is expected to continue to provide attractive opportunities to residents of other provinces.

The net result is the healthy growth of the provincial labour force and employment growth averaging 2.0 percent per year.

The unemployment rate is expected to decline steadily through the forecast, falling from nine percent in 1990 to five percent by 2010. Net migration into British Columbia is projected to remain between 35,000 and 40,000 persons per year, noticeably higher than during the early and mid-1980s when net migration averaged about 10,000. Provincial population is expected to grow by 1.8 percent per year in the early 1990s and to slowly decrease to a 1.5 percent average annual rate by the year 2005.

Inflation, as measured by the rate of change in the Vancouver consumer price index is expected to rise to 6.3 percent in 1991, with the introduction of the Federal Goods and Services Tax. By 1993, however, inflation is expected to be down to 4.3 percent, declining gradually from there to reach 3.5 percent by the year 2000.

Residential Energy Prices

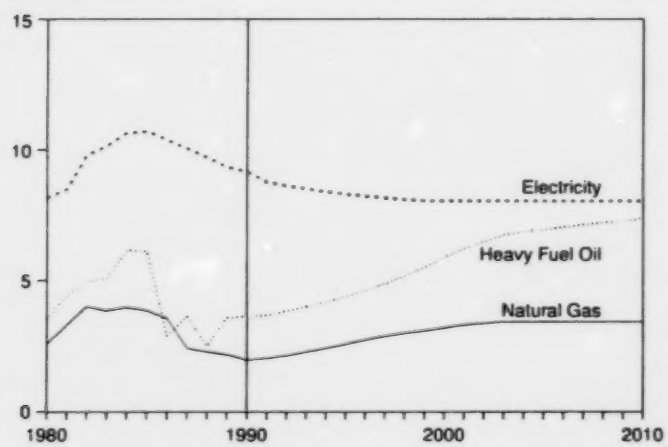


GOODS AND SERVICES TAX

The Federal Goods and Services Tax (GST) which took effect on January 1, 1991, is assumed to have the following implications:

- a seven percent increase in the retail price of residential electricity, natural gas, heating oil, and other fuels;
- no net effect on commercial and industrial energy costs, since any increase in initial price is assumed to be recovered through the GST credit;
- no change in the price of gasoline or other transportation fuels; and
- a 1.25 percentage point increase in the provincial inflation rate, but no impact on real economic growth.

Large Industrial Energy Prices



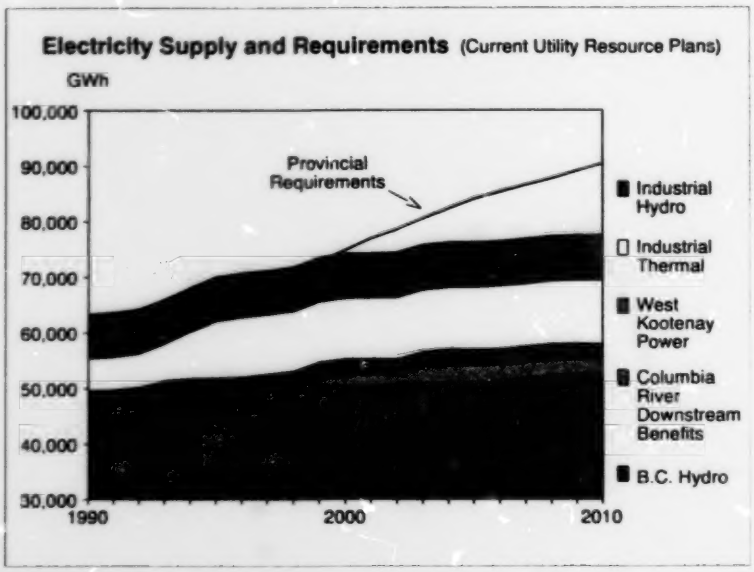
ENERGY EFFICIENCY

Energy demand is determined primarily by economic and demographic growth and energy prices. However new government and utility efficiency programs are expected to have significant impacts on British Columbia energy consumption.

Electricity

In 1990, electricity comprised approximately 21 percent of total provincial end use energy requirements. Electricity's market share is expected to reach 25 percent of total energy consumption by 2010.

There are two major electric utilities in British Columbia — one publicly owned (B.C. Hydro) and the other privately owned (West Kootenay Power) — which together produce 81 percent of provincial electricity. Industry accounts for the remainder of power generation, primarily for ore smelting and pulp and paper production. Currently over 90 percent of provincial power generation is hydro-based with the remainder generated from thermal sources.



PRICES

Retail electricity prices are regulated by the B.C. Utilities Commission. Due to declining average costs, prices fell in real terms during the 1980s. This trend is expected to continue through the next decade, but will be offset somewhat by rising new supply costs and the need to promote energy efficiency. Electricity rates will rise by slightly less than the rate of inflation, on average, and by 2010 real electricity rates will be six percent lower than current levels.

The forecast for nominal (unadjusted for inflation) electricity prices includes B.C. Hydro's approved rate increases for 1990 and 1991 (1.5 percent per year), three percent per year growth to 1999, and 3.5 percent annual growth thereafter. This forecast is consistent with provincial policy to ensure smooth and stable rate increases. It does not include any proposals for rate restructuring, which will be the subject of a Utilities Commission hearing in 1991.

Current retail prices for electricity are $12.97 per GJ for residential use and $9.17 per GJ for large industrial.

REQUIREMENTS

Total domestic electricity requirements are forecast to grow at 2.2 percent per year over the forecast period, compared to an average annual 3.1 percent during the 1980s. The major source of growth is a process shift in the pulp and paper industry. Production of electricity intensive mechanical pulps, rather than chemical pulps, will increase. Increased use of electrical equipment and processes in secondary manufacturing (food and beverage industry, etc.) and the commercial sector represent another growth area.

Requirements are net of energy efficiency programs by electric utilities and government, which together reduce demand by an estimated 6900 GW.h (25 PJ) in 2010.

Losses in transmission account for nearly 10 percent of total electricity use.

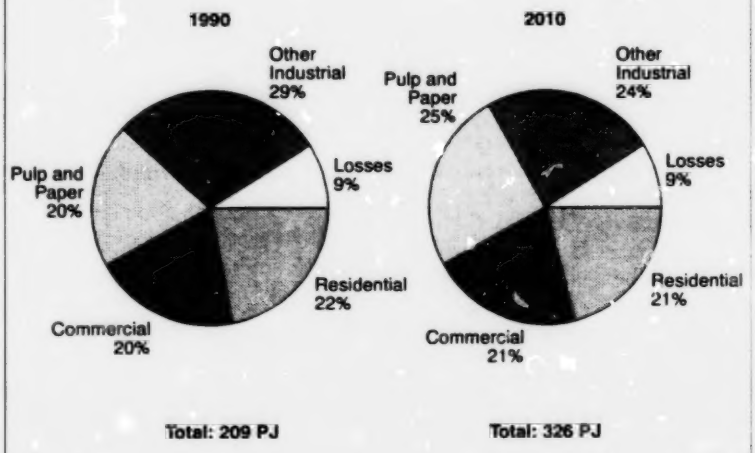
SUPPLY

Due largely to B.C. Hydro purchasing initiatives, private sector power production is expected to increase over the forecast period. Including West Kootenay Power, private sector generation will grow from 20 percent to 25 percent of total electricity production in the next 20 years.

Thermal electricity generation is based on heavy fuel oil, diesel fuel, natural gas, and forest wastes. Diesel oil is used in remote areas of British Columbia that are not connected to the provincial power grid. The majority of current thermal generation is divided between B.C. Hydro's Burrard gas-fired plant and pulp mills which cogenerate power and process steam from fossil fuels and forest wastes.

Thermal generation is forecast to increase from 8,000 GW.h in 1990 to 13,000 GW.h by 2010. B.C. Hydro is making arrangements to purchase thermal electricity from private industry and to encourage cogeneration in the pulp and paper sector. Recently, Hydro signed an agreement with Howe Sound Pulp and Paper Co. for a wood-waste-fired cogeneration plant that will provide 700 GW.h (2.5 PJ) of electric energy per year.

Electricity Consumption by Sector



Other major new sources of power supply planned for the province include:

- refurbishments to B.C. Hydro's existing facilities ("Resource Smart");
- Alcan's Kemano Completion hydroelectric project;
- Columbia River Treaty power returned from the United States;
- hydro electric projects on the Lower Columbia; and
- purchases from neighbouring systems.

SUPPLY-REQUIREMENTS BALANCE

Based on forecast requirements and current utility resource plans, additional supplies of electricity will be required to be in-service around the year 2000. This shortfall could be met by a variety of supply options such as additional private power and cogeneration, further Lower Columbia development, small hydro projects (under 5 MW), new geothermal projects, or a major new hydroelectric dam such as the proposed Site C project on the Peace River. Additionally, demand side management programs such as Power Smart and Power Sense could be expanded to reduce electricity demand.

EXPORTS

The forecast of domestic requirements above excludes both firm and interruptible exports of electricity to the United States. In the past 10 years, these exports have been volatile, averaging about 6200 GW.h (22.5 PJ) per year.

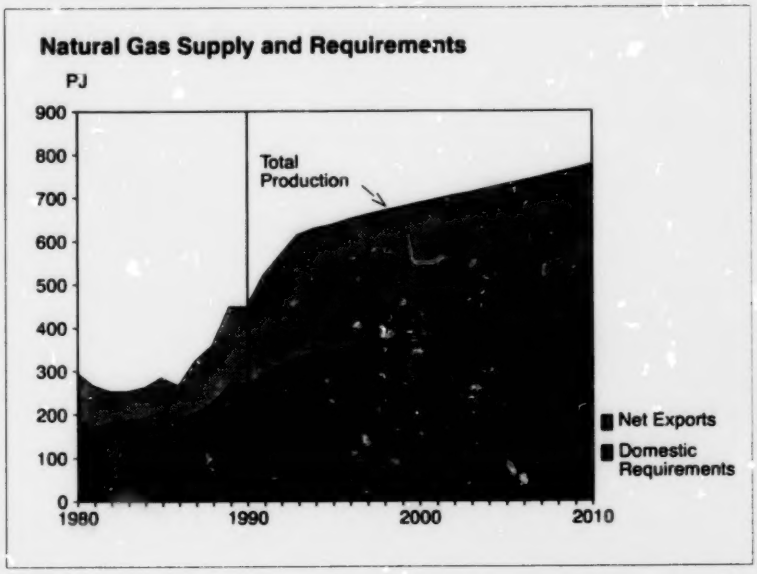
Natural Gas

In 1990, natural gas comprised approximately 22 percent of total provincial end use energy requirements, giving it the second largest fuel market share behind oil products. Over the forecast period natural gas is expected to be the fastest growing energy source in British Columbia, making up 27 percent of total energy consumption by 2010.

Natural gas is produced in Northeastern British Columbia (part of the Western Canadian Sedimentary Basin) and is brought to market by Westcoast Energy Inc.'s transmission pipeline. Utilities (BC Gas Inc., Pacific Northern Gas, and Centra gas) then carry the gas to final consumers on their distribution systems.

DEREGULATION

British Columbia is continuing the process of deregulating natural gas supply which began in the mid-1980s. Deregulation has led to increased competition and lower prices in several markets. In November 1990, new procedures for approving long-term natural gas exports took effect. These procedures are intended to be more flexible and to open up new gas markets, stimulate exploration and development, and ensure domestic security of supply.



PRICES

Since deregulation in 1986, natural gas prices in British Columbia have been determined through negotiation between producers, marketers, and distributors. At the retail level, natural gas prices remain regulated for "core market" (residential, commercial, and small industrial) customers. Large industrial customers can negotiate their own prices.

Since the mid-1980s, gas prices have been declining in real terms, due to deregulation and surplus productive capacity. Prices are forecast to firm up in the next few years as North American surpluses are eliminated. Over the entire forecast period, natural gas prices will rise faster than oil and electricity prices, at an average real growth rate of 1.6 percent per year. Nevertheless, gas will remain the least expensive fuel in all markets.

Current retail prices for natural gas average $4.62 per GJ for residential and $1.99 per GJ for large industrial users.

REQUIREMENTS

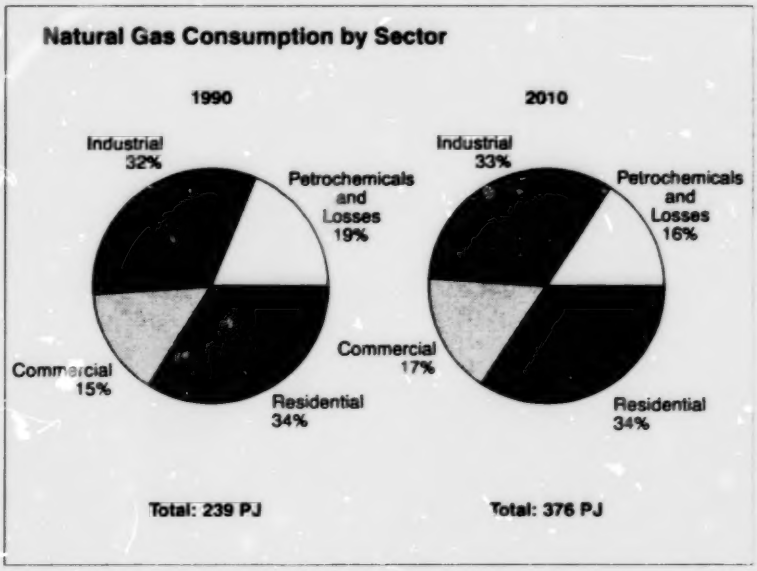
Total domestic primary requirements are forecast to grow at 2.4 percent per year on average between 1990 and 2010, compared to 3.7 percent over the past decade. The Vancouver Island natural gas pipeline is the principal source of growth, adding 22 PJ of demand by 2000.

By sector, the pulp and paper industry is a key contributor to demand growth. Seven pulp mills on Vancouver Island and the coastal mainland will convert from heavy fuel oil to natural gas in the next few years. In addition, demand should be stimulated through lower-priced direct purchases from gas producers.

A continuing growth area will be new residential and commercial construction in the Lower Mainland, where natural gas is expected to capture space and water heating loads from oil and electricity.

Requirements are net of energy saved through provincial efficiency programs (appliance and building standards).

The use of natural gas for thermal electricity generation is expected to double over the next 20 years, from 30 PJ in 1990 to 59 PJ by 2010.



SUPPLY

As of the end of 1989, British Columbia's remaining established reserves of marketable natural gas were about 210 billion cubic metres(m^3) or 8100 PJ. At current rates of production this translates into about 20 years of domestic reserves. Undiscovered gas potential represents a further 60 years of estimated supply.

Additions to natural gas reserves result from new discoveries and from revisions to existing reserve estimates. In 1989, 10 billion m^3 (380 PJ) of new gas were added to reserves, mainly due to additions in the Sukunka area south of Chetwynd and upward revisions in the Ring Border area.

Because of deregulation and increased exports, exploration and development activity has steadily increased since the mid-1980s. Total gas wells drilled have increased from 31 in 1984 to 84 in 1989.

Over the forecast period, additions to reserves from new discoveries are expected to average 12 billion m^3 (460 PJ) per year. In total, natural gas production from established reserves and new discoveries will rise from 12 billion m^3 (460 PJ) in 1990 to 20 billion m^3 (780 PJ) in 2010.

British Columbia also has considerable potential natural gas supply from coal beds. However, since it is unlikely to contribute to supply within the projection period, there has been no explicit allowance made for coal seam gas.

EXPORTS

British Columbia's traditional export market for natural gas has been the U.S. Pacific Northwest. Increased thermal generation in the Northwest and long-term exports to California and Ontario are expected to provide increasing export opportunities over the forecast period.

Between 1990 and 2010, exports are forecast to grow at an average rate of 3.4 percent per year, increasing their share of total (domestic plus export) gas production from 40 to 45 percent.

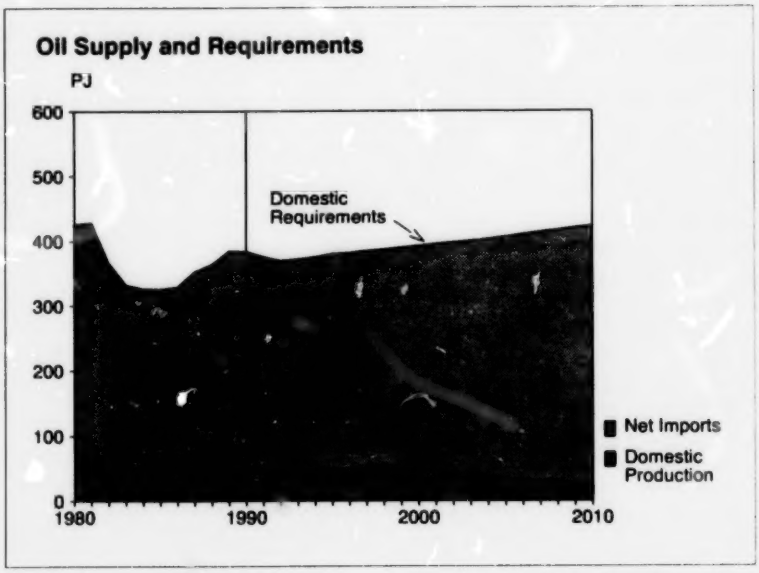
SUPPLY-REQUIREMENTS BALANCE

In 1990, marketable gas productive capacity (producibility) exceeded domestic and export requirements by approximately 40 percent. Over the forecast period this surplus is expected to decline. However, provincial supplies should remain more than adequate to meet forecast demand and export requirements past 2010.

Oil

British Columbia supplies only 19 percent of its oil needs, from conventional crude oil resources in the Northeast. The province's principal source of supply is Alberta, along with small quantities of refined petroleum products (RPPs) from the United States.

Trans Mountain Pipe Line Co. operates the main transmission line carrying Alberta and B.C. crude oil and products to Lower Mainland refineries. Currently, there are six refineries in the province producing around 60 million barrels of refined product per year. Supplies from Alberta now include semi-refined feedstocks for further processing in the Vancouver area.

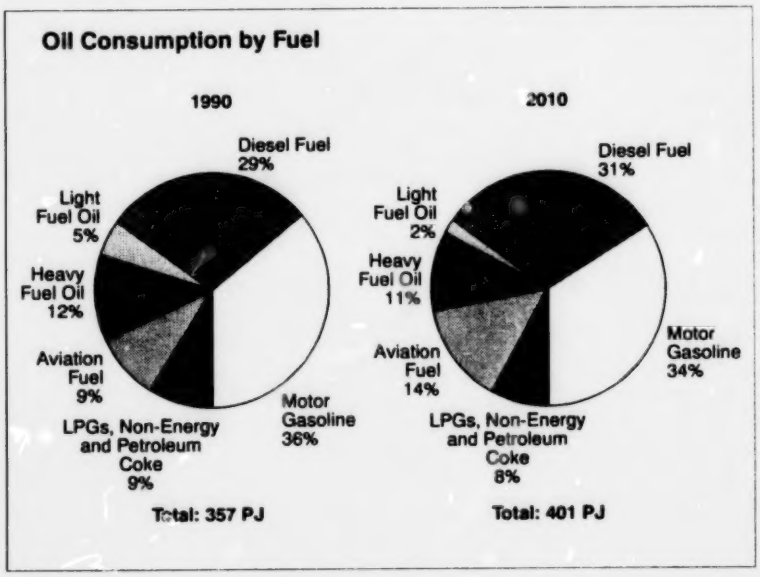


PRICES

Prices of refined petroleum products (e.g., motor gasoline and home heating oil) are determined by competition, based on the cost of crude oil delivered to Vancouver, refining costs, provincial and federal consumption taxes, and distribution costs. Prices declined after 1985, as surplus production and reduced demand led to lower world oil prices.

Given the underlying world oil price forecast, RPP prices are projected to remain low in the medium-term due to the cost of crude and competition from other fuels. Over the forecast period, prices do grow in real terms, although at rates lower than those expected for natural gas.

Continued tensions in the Middle East Gulf are likely to result in continued price volatility. However, nothing has impacted on long-term supply-demand fundamentals; these will continue to dictate



world prices for the next 20 years.

REQUIREMENTS

Total oil requirements are forecast to grow at 0.5 percent per year over the forecast period, compared to an average annual decline of 1.0 percent during the 1980s. Consumption will fall in the residential, commercial, and industrial sectors, due largely to the Vancouver Island natural gas pipeline but also due to a general off-oil trend.

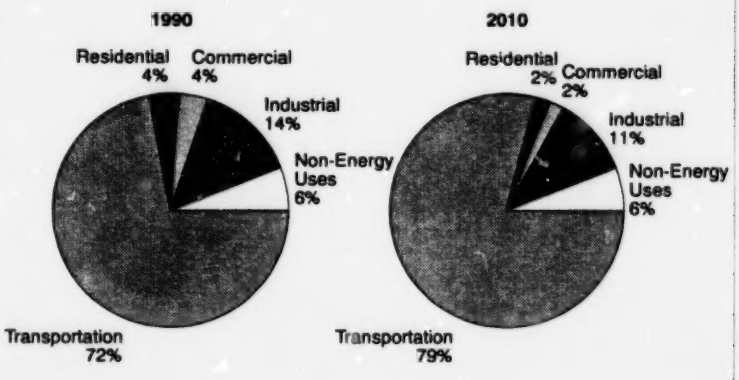
Demand growth comes mainly from the transportation sector, where there are few economical substitutes for gasoline and diesel fuel. Transportation oil requirements are forecast to grow by 1.1 percent annually between 1990 and 2010. Most of this growth is in road transport.

Non-energy uses of refined oil products for asphalt production and lubricating oils and greases account for six percent of total requirements.

Refinery own-use of oil products should decline over the forecast as the industry down-sizes.

The use of refined petroleum products in thermal electricity generation is also expected to decline over the next 20 years, from 5.7 PJ in 1990 to 2.0 PJ by 2010, due primarily to reductions in thermal generation in remote regions of the province.

Oil Consumption by Sector



SUPPLY

Less than three percent of Canada's conventional crude oil resources are located in British Columbia. The province has 17 million cubic metres (m^3) or 650 PJ of remaining established reserves, amounting to a reserve life of 10 years at current production levels. This reserve life could be doubled with the application of enhanced oil recovery (EOR) techniques.

There have been two major British Columbia oil finds in the last 10 years, including a 1988 find of 2 million m^3 (77 PJ) at Brassey, southwest of Dawson Creek. Furthermore, exploration and drilling activity has rebounded recently. In 1989, the total number of oil wells drilled increased from 37 to 54.

Over the forecast period, annual additions to oil reserves from new discoveries are projected to average 0.5 million m^3 (19 PJ) per year. Total production from remaining established reserves, new discoveries, and EOR is expected to decline from 1.9 million m^3 (73 PJ) in 1990 to 0.6 million m^3 (24 PJ) in 2010.

The forecast assumes the closure of one refinery during the 1990s, as part of a rationalization of the industry.

SUPPLY-REQUIREMENTS BALANCE

In the absence of major new finds or significant EOR development, imports will increase their share of total provincial oil requirements from 81 percent to 94 percent by the end of the forecast period.

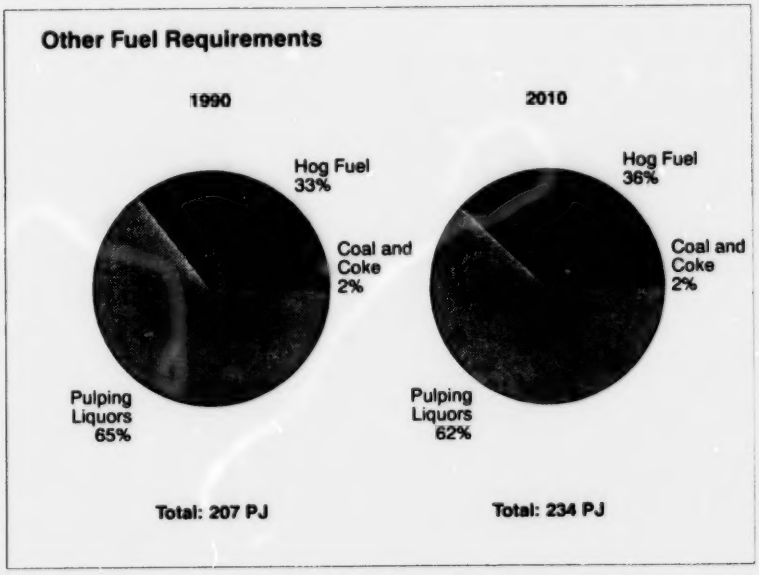
Other Fuels

Other fuels consumed in British Columbia include coal and coke, wood-wastes, spent pulping liquors and waste gases. Total requirements for these fuels will tend to level out over the forecast period, growing at an average 0.8 percent per year as compared to 1.4 percent in the 1980s.

B.C Hydro is encouraging cogeneration in the pulp and paper sector and is expected to be purchasing thermal electricity generated by private industry. The use of other fuels for thermal electricity generation is expected to increase over the next 20 years, from 9.5 PJ in 1990 to 20.6 PJ by 2010.

Wood-wastes or hog fuel (bark, sawdust, slash, etc.) and pulping liquors (created in the pulp-making process) are forest industry by-products used by pulp and paper mills to produce steam or process heat and to generate power.

Small amounts of coal and coke are consumed in smelting, pulp and paper production, and other industrial uses. The major energy use for coal, in British Columbia, is for the drying of metallurgical coal by the coal mining industry.



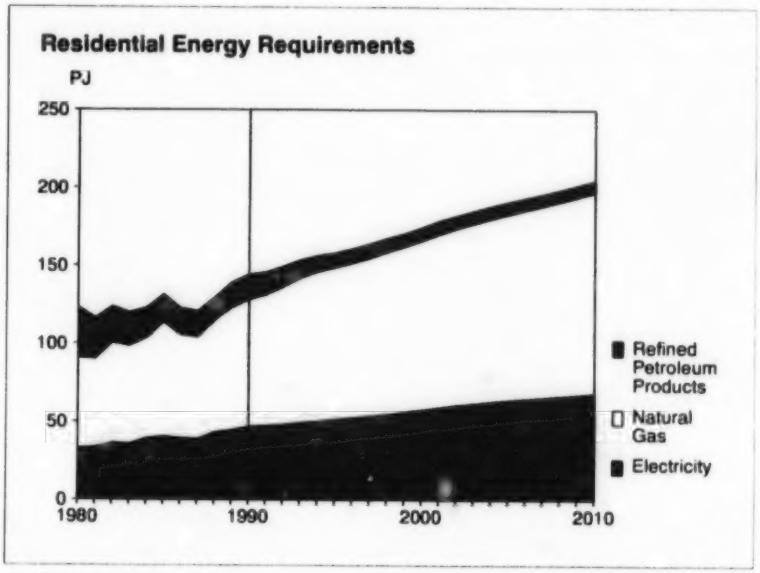
Sectoral Requirements

RESIDENTIAL

Households consume energy for lighting, space and water heating, and operation of appliances. In British Columbia, residential needs are met mainly by natural gas (56%) and electricity (33%), with some light fuel oil (11%) in areas lacking access to natural gas.

Over the 1990-2010 period, total requirements are forecast to grow at an average rate of 1.8 percent per year, in pace with growth in the total housing stock. Oil will lose market share primarily to natural gas, as a result of gas service to Vancouver Island.

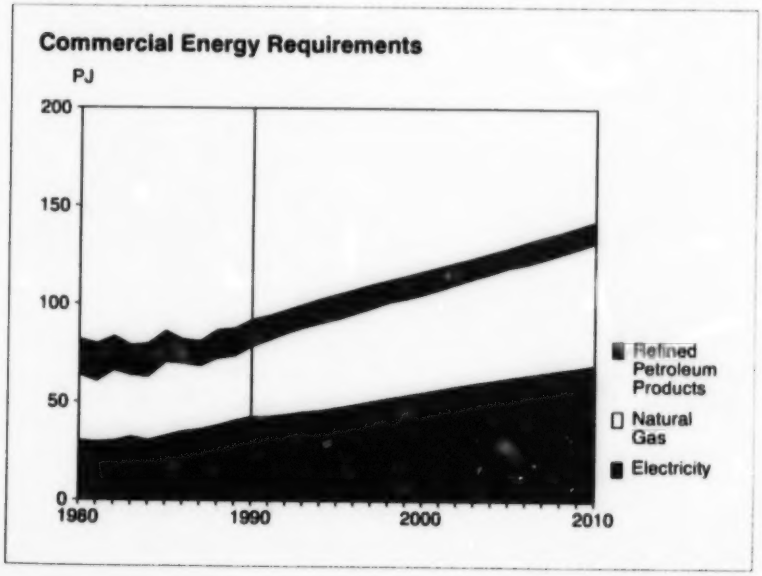
There have been significant gains in the energy efficiency of homes during the past fifteen years due to rising energy prices, better home design, and government programs. Energy use per household declined between 1980 and 1990, while electricity use per household increased with off-oil substitution and rising penetration of electrical appliances.



COMMERCIAL

Businesses consume energy for lighting, space heating and cooling, water heating, motors, and other equipment. Electricity (46%), natural gas (39%), and some light fuel oil (15%) make up total requirements.

Commercial demand is expected to grow at an average annual rate of 2.2 percent through 2010, led by steady growth in wholesale and retail trade, education, health, and other services. Oil will lose market share to both gas and electricity because of higher prices, extension of gas service,



and growth of various electricity-intensive applications.

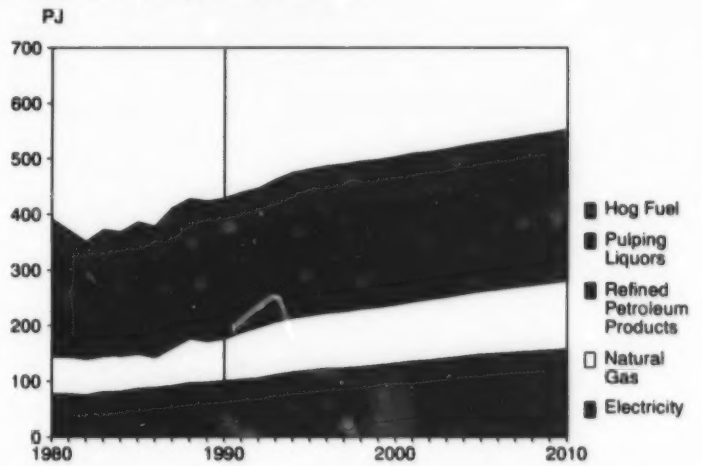
Over the past decade, better building design has led to substantial improvements in commercial energy efficiency. Energy use per dollar of commercial sector GDP has fallen by 19 percent since 1980 and will continue to do so, as new buildings replace the older, less-efficient stock.

INDUSTRIAL

The industrial uses of energy include heating, lighting, powering of machines, and industry-specific processes. Requirements in this sector are met by "other" fuels such as wood waste and spent pulping liquors (47%), electricity (23%), natural gas (18%), and oil products (12%). Industrial demand will grow at an average rate of 1.3 percent annually.

A major factor affecting the forecast is a production shift expected to occur in the pulp and paper industry, which accounts for over 60 percent of industrial energy needs. Thermo-mechanical pulping (TMP) is expected to increase its share of total pulp output from 25 to 45 percent in 2010. Compared to traditional chemical pulping, TMP is about four times as electricity intensive and transforms some 95 percent (versus 50 percent) of the wood input into pulp.

Industrial Energy Requirements

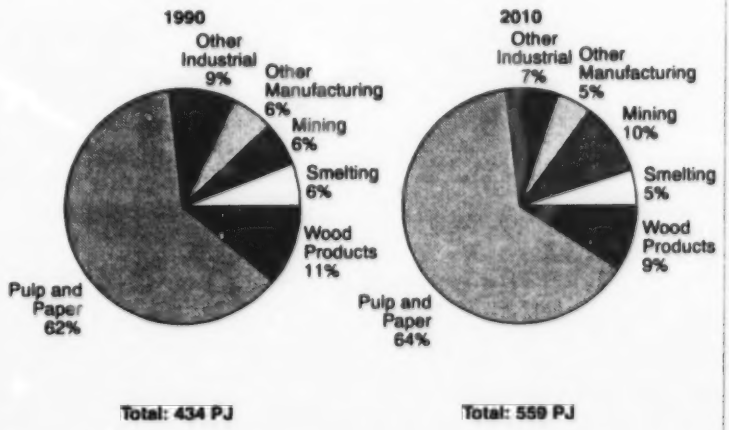


Generally, a shift from market pulp, and in particular chemical pulp, to TMP and newsprint will reduce the potential for energy production from waste by-products (i.e., pulping liquors) in this industry.

Overall, the market share of other fuels will decline five percentage points in the industrial sector. The market share of heavy fuel oil will also decline due to the extension of natural gas service and the conversion of pulp mills on Vancouver Island.

Industrial energy use per dollar of GDP has remained high over the past decade, buoyed by British Columbia's energy intensive resource-based industries. In individual industries, however, energy use per unit of output has declined. Over the forecast horizon, total energy per dollar of GDP will decline as a result of more efficient equipment, a move to more efficient energy forms (electricity), and the growth of less energy intensive industry.

Industrial Energy Requirements by Sub-Sector

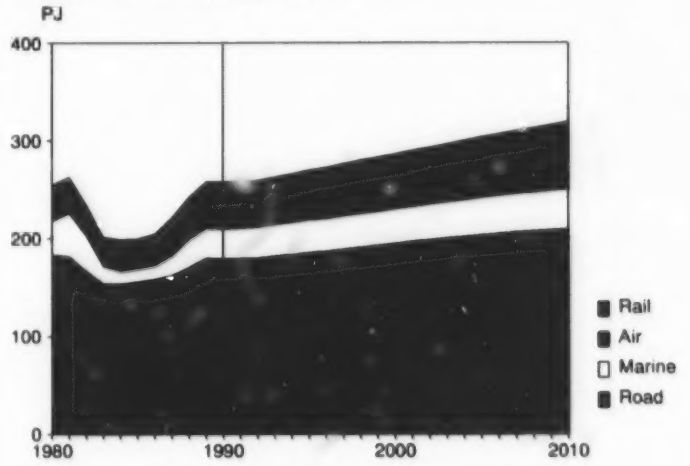


TRANSPORTATION

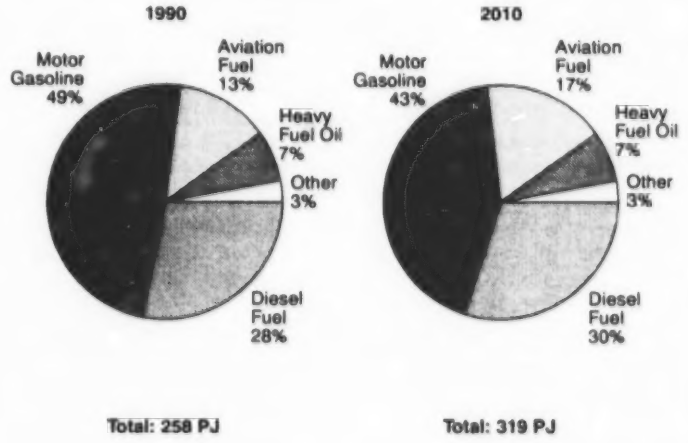
Energy use for road, rail, air, and marine transport is met almost entirely by oil products. The remainder includes natural gas, propane (road vehicles and marine), and electricity (e.g. Vancouver's light rail transit). Total requirements are expected to grow at an average 1.1 percent per year, compared to no growth overall in the 1980s.

Energy consumption by road vehicles makes up almost 70 percent of total transportation energy requirements. Road energy use actually declined from 1980 to 1990, due to a large improvements in fuel efficiency. Although lower oil prices worked against this trend in the late 1980s, automobile fuel efficiency is expected to continue to improve over the forecast period. Total road requirements will grow, however, because of an increase in the number of vehicles driven. By 2010, road transportation energy requirements are expected to be only 14 percent greater t[illegible] their 1980 levels.

Transportation Energy Requirements



Transportation Energy Requirements by Fuel

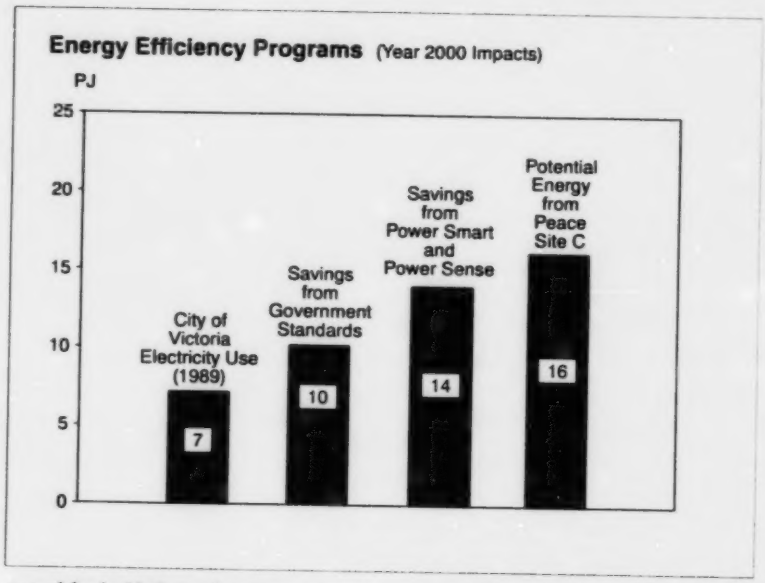


Efficient Energy

A major new policy thrust for British Columbia in the 1990s will be to improve the efficiency of our energy use, in other words, to cut energy waste in all areas.

Because the forecast is based on the historical relationships between energy consumption, prices and economic activity, it implicitly includes "natural conservation" of energy. This natural conservation refers to reductions in energy use made by individuals, businesses, and industry as a result of rising energy prices and other factors.

In addition, the forecast includes the impacts of utility and government programs to cut energy waste:



UTILITY PROGRAMS

British Columbia's electric utilities are actively pursuing programs to encourage their customers to use electricity efficiently.

B.C. Hydro's Power Smart programs cover a range of sectors and uses, including cash rebates for the purchase of energy-efficient appliances and industrial motors. A total electricity saving of 3900 GW.h/yr is expected for the year 2000, at a cost of roughly half that of new generation facilities.

West Kootenay Power has a similar series of programs known as Power Sense, which includes grants and loans to customers for home insulation. Energy savings for the year 2000 are estimated at 101 GW.h.

APPLIANCE STANDARDS

Under British Columbia's new Energy Efficiency Act, minimum energy efficiency standards will be set for new appliances, motors, and other equipment.

BUILDING STANDARDS

For the forecast, it is also assumed that 1992 revisions to the B.C. Building Code will include energy efficiency standards for new residential and commercial buildings.

Clean Energy

A second policy thrust for the 1990s is to reduce the environmental impacts of energy use and shift to cleaner fuels.

RENEWABLE ENERGY

British Columbia's use of renewable energy is more than twice the Canadian average. Renewable energy consists of both hydroelectricity and forest wastes:

Clean Hydro

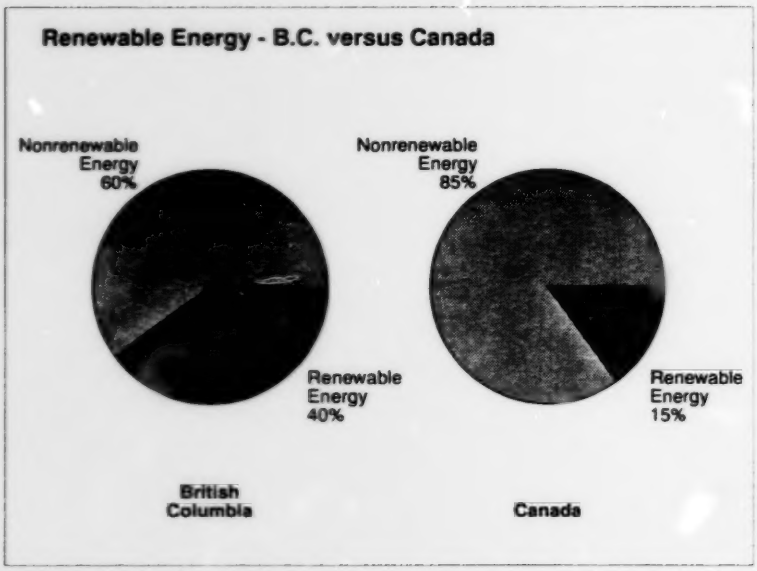
Alcan's Kemano Completion hydroelectric project is a major low-cost power source requiring no new reservoirs or river diversions, and providing enhanced fisheries mitigation. The return of Columbia River Treaty power produced downstream in the United States is another source of low-cost electricity with no new flooding impacts.

Energy from Waste

A new wood waste facility has been approved for Williams Lake, to generate energy and reduce local air pollution caused by the conventional burning of sawmill wastes. B.C. Hydro will pay a higher price ("environmental premium") for power purchased from this plant.

FUEL SWITCHING

Switching to cleaner-burning fuels such as natural gas can improve the local and regional environment. By displacing fuel oil, the Vancouver Island natural gas pipeline will reduce sulphur emissions and cut oil tanker traffic in the Georgia Strait.



CARBON DIOXIDE EMISSIONS

Recently, the province completed an inventory of man-made carbon dioxide (CO_2) emissions in British Columbia. Over two-thirds of current emissions were found to be energy-related. Energy-related emissions were forecast to grow by 25 percent between 1990 and 2010.

Natural gas produces less carbon dioxide than other fossil fuels on a per unit basis. However, its share of provincial emissions is expected to increase because of the growth in total gas demand.

Measures to control CO_2 emissions include improving energy efficiency and switching to lower carbon fuels.

ALTERNATIVE FUELS

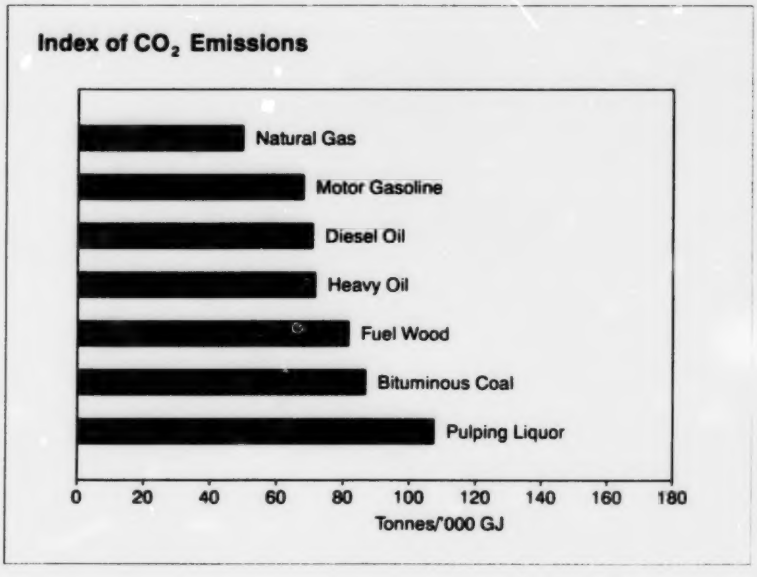
Displacing gasoline and diesel oil with alternative transportation fuels can reduce urban smog and greenhouse gas emissions.

Natural Gas

There are currently over 9,500 natural gas vehicles (NGV) in the province. Over the forecast period, NGV is expected to capture market share from motor gasoline. B.C. Gas' recent proposal promoting home NGV compressors may increase the penetration of NGV beyond forecast levels.

Hydrogen

Vehicles powered by hydrogen would produce virtually no air pollutants. Using fuel cells, electricity can be generated directly from hydrogen and oxygen. The province is involved in a bus fuel cell demonstration project based on technology developed by a North Vancouver firm, Ballard Power Systems Inc.



Glossary

Cogeneration
The simultaneous production of electricity and usable heat from a single fuel source.

Commercial Sector energy requirements
Energy used by institutions and all service industries except for transportation.

Conversion losses
Energy used in converting fossil and other fuels to electricity, and in refining crude oil to make oil products.

Energy efficiency
Using less energy to get the same or better level of energy service.

Enhanced oil recovery (tertiary recovery)
Oil recovery techniques beyond those that use the natural pressure of the reservoir (primary recovery) or water-flood (secondary recovery). Usually involves flooding the reservoir with other hydrocarbons such as natural gas or gas liquids.

Firm energy
Energy provided on a contracted basis whereby supply is guaranteed by the seller.

Forest wastes
Wood waste/hog fuel (bark, sawdust, slash, etc.) and spent pulping liquors generated as by-products in the forestry sector.

Fuel cells
Technology that operates like a constantly-charged battery to generate electricity from another fuel source (hydrogen, solar, etc.)

Goods and Services Tax (GST)
Federal value-added tax which will apply to the majority of consumer goods and services, and will replace the Manufacturers' Sales Tax.

Greenhouse gas emissions
Emissions from motor vehicles, industrial plants, thermal power facilities, and other sources which contribute to the buildup of carbon dioxide and other greenhouse gases in the lower atmosphere. Linked by many scientists to a warming of world temperatures.

Industrial Sector energy requirements
Energy used by all manufacturing industries, forestry, and mining.

Interruptible energy
Energy supply which may be interrupted at the seller's discretion.

Minimum energy efficiency standards
Standards specifying energy efficiency requirements (e.g., insulation R-values, maximum energy consumption levels) for new buildings or equipment.

Non-energy use
Use of fuel for non-energy purposes such as feedstocks in the production of petrochemicals and lubricating oils and greases.

Own use
Energy used by the energy industry itself in producing and delivering energy to final consumers.

Primary energy requirements
Secondary energy requirements plus the "indirect" requirements used to produce energy — i.e., fuels used to convert from one energy form to another. Includes own use by the energy industry.

Refined petroleum products
Fuels produced from the refining of crude oil including motor gasoline, diesel fuel, light fuel oil (heating oil), aviation fuel, and heavy fuel oil.

Residential Sector energy requirements
Energy used by all household units (including multi-family dwellings) and agriculture.

Secondary energy requirements
Energy consumed at the point of use — for heating, lighting, powering of motors, industrial processes, etc. Includes non-energy use and own use by the energy industry.

Transportation Sector energy requirements
Energy used by road, rail, air, and marine transportation.

West Texas Intermediate (WTI)
Benchmark world oil price at Cushing, Oklahoma.

Detailed Tables

MACROECONOMIC ASSUMPTIONS

(% growth rate)

	Population	Housing Stock	Total GDP	Commercial GDP	Industrial GDP	Vancouver CPI
1980–1990	1.7	2.3	2.5	3.1	1.5	5.7
1989–1990	2.4	2.7	3.0	3.5	3.0	5.4
1990–1991	2.1	2.3	1.5	2.5	–0.6	6.1
1990–1995	1.9	2.0	2.9	3.0	2.5	4.6
1995–2000	1.8	1.9	3.0	3.3	2.2	3.7
2000–2005	1.6	1.7	2.6	2.8	2.2	3.5
2005–2010	1.3	1.5	2.3	2.5	2.0	3.5
1990–2010	1.7	1.8	2.6	2.9	2.2	3.8

Source: Ministry of Finance and Corporate Relations, British Columbia Long-Term Economic Forecast; 1990–2010, May 1990.

ENERGY PRICE ASSUMPTIONS

($1990/GJ)

	Crude Oil (West Texas Intermediate)	Refined Petroleum Products		Natural Gas		Electricity
	$1990 U.S./Bbl	Motor Gasoline	Light Heating Oil	Field	Burner Tip	
1990	20.32	17.78	9.39	1.30	4.62	16.03
1995	22.30	18.23	10.31	1.96	5.45	15.71
2000	29.20	19.67	11.37	2.71	6.20	15.20
2005	31.50	20.61	12.05	2.99	6.47	15.20
2010	31.50	20.93	12.28	2.99	6.47	15.20
1990–2010 (%)	2.2	0.8	1.3	4.3	1.7	–0.3

Prices for light heating oil, natural gas (burner tip) and electricity are for the residential sector and include applicable provincial and federal taxes. Natural gas field prices are averages across all sectors.

PRIMARY AND SECONDARY REQUIREMENTS BY FUEL

(PJ)

	1980	1985	1990	1995	2000	2005	2010	GR8090	GR9010
Electricity	154.1	177.2	209.5	240.0	269.7	303.1	326.0	3.1	2.2
Natural Gas	177.2	203.8	238.8	294.0	320.1	347.7	375.6	3.0	2.3
Refined Petroleum Products	402.9	301.7	357.5	354.2	369.0	384.1	401.5	-1.2	0.6
Motor Gasoline	152.2	124.8	127.2	127.4	131.0	134.8	136.7	-1.8	0.4
Diesel Fuel	94.6	85.2	103.0	109.7	114.8	119.7	124.7	0.8	1.0
HFO	55.0	25.4	42.8	37.1	39.1	41.5	44.6	-2.5	0.2
LFO	35.3	19.5	18.2	10.4	9.4	8.2	7.9	-6.4	-4.1
Aviation Gas	1.6	1.0	1.3	1.4	1.6	1.8	2.0	-2.0	2.3
Aviation Turbo	24.7	18.5	33.4	35.9	40.7	45.4	52.3	3.1	2.3
LPGs	7.9	9.0	9.8	8.9	9.0	8.9	9.2	2.1	-0.3
Petroleum Coke	8.7	3.3	4.1	5.1	5.1	5.1	5.1	-7.2	1.1
Non-Energy	22.9	15.0	17.7	18.3	18.3	18.7	19.0	-2.6	0.3
Other	183.9	188.2	206.7	226.8	228.2	229.7	234.0	1.2	0.6
Pulping Liquors	116.9	115.9	133.0	142.3	141.5	141.7	143.9	1.3	0.4
Hog Fuel	64.2	69.0	68.8	79.2	81.3	82.3	84.3	0.7	1.0
Coke and Coal	2.8	3.3	4.0	4.0	4.0	4.0	4.0	3.5	0.0
Other	0.0	0.0	0.9	1.3	1.4	1.6	1.8	0.0	3.5
Total Secondary	**918.1**	**870.9**	**1012.5**	**1115.0**	**1187.0**	**1264.6**	**1337.1**	**1.0**	**1.4**
Electricity Generation by Fossil Fuel	-9.2	-7.5	-19.0	-43.1	-44.8	-45.8	-47.0	7.5	4.6
Gas Converted to Electricity	8.5	3.0	29.7	54.4	57.1	58.1	59.3	12.0	3.5
RPPs Converted to Electricity	5.4	5.4	5.7	2.0	2.0	2.0	2.0	2.1	-5.1
Other Fuel Converted to Electricity	8.4	6.5	9.5	20.3	20.4	20.4	20.6	1.2	3.9
RPP Own Use	18.0	18.8	20.7	19.3	17.2	15.2	14.3	1.1	-1.8
Own Use by Coal Mines	0.0	2.0	5.2	5.6	6.0	6.4	6.7	0.0	1.3
Total Primary	**949.2**	**899.1**	**1064.3**	**1173.5**	**1244.9**	**1320.9**	**1393.0**	**1.1**	**1.4**

Column titles GR8090 and GR9010 denote average annual growth rates over the periods 1980–1990 and 1990–2010.

PRIMARY AND SECONDARY REQUIREMENTS BY SECTOR

(PJ)

	1980	1985	1990	1995	2000	2005	2010	GR8090	GR9010
Residential	123.3	131.9	144.6	158.5	174.8	191.1	204.9	1.6	1.8
Commercial	82.1	86.2	92.1	105.4	117.1	129.1	142.6	1.2	2.2
Industrial	392.8	388.9	434.5	487.1	508.9	534.7	558.9	0.9	1.3
Pulp and Paper	239.1	236.5	270.7	314.1	327.0	343.4	356.4	1.3	1.4
Wood Products	46.3	48.1	49.0	50.9	51.4	50.8	50.5	0.6	0.1
Chemicals	12.2	10.0	12.0	12.7	13.2	13.4	13.4	–0.1	0.6
Primary Metals	30.5	28.7	27.1	27.6	27.6	27.6	27.6	–1.2	0.1
Non-Metallic Minerals	13.3	3.8	5.4	5.7	6.0	6.4	6.8	–8.6	1.2
Mining	21.5	28.7	25.1	27.0	25.3	24.9	26.4	1.6	0.3
Other Manufacturing	11.2	17.4	26.7	30.0	38.6	47.6	56.6	9.1	3.8
Other Industrial	11.7	9.4	16.0	16.7	17.6	18.5	19.3	3.1	0.9
Petrochemicals	0.6	1.0	0.6	0.6	0.6	0.6	0.6	–0.6	0.0
Refinery	6.4	5.3	1.9	1.8	1.6	1.5	1.3	–11.6	–1.8
Transportation	254.6	199.9	257.9	270.2	286.5	303.5	319.4	0.1	1.1
Road	183.3	156.0	179.1	185.4	194.6	203.4	209.5	–0.2	0.8
Rail	10.2	11.0	13.2	13.6	13.7	13.8	14.3	2.6	0.4
Air	26.2	19.5	34.7	37.4	42.2	47.1	54.3	2.8	2.3
Marine	34.9	13.4	30.9	33.8	36.0	39.2	41.3	–1.2	1.5
Other	65.3	64.0	83.4	93.8	99.7	106.2	111.3	2.9	1.5
Petrochemical Feedstock	1.8	18.2	25.1	25.1	25.1	25.1	25.1	29.9	0.0
Other Non-Energy	31.6	18.1	21.1	22.6	22.7	22.9	23.3	–4.0	0.5
Pipelines	15.2	11.9	18.1	24.7	27.4	29.8	32.2	1.8	2.9
Losses	16.7	15.8	19.1	21.4	24.5	28.4	30.7	3.3	2.4
Total Secondary	**918.1**	**870.9**	**1012.5**	**1115.0**	**1187.0**	**1264.6**	**1337.1**	**1.0**	**1.4**
Electricity Generation	13.1	7.4	25.9	33.6	34.7	34.7	34.9	6.8	1.5
Own Use	18.0	20.8	25.9	24.9	23.2	21.6	21.0	3.3	–1.0
Total Primary	**949.2**	**899.1**	**1064.3**	**1173.5**	**1244.9**	**1320.9**	**1393.0**	**1.1**	**1.4**

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